**REMARKS:**

Claims 1-10 are in the case and presented for consideration.

Applicants have rewritten independent claims 1, 5, 6 and 9 to improve clarity and understanding of the claims. No new matters have been added. The changes and/or additions are not required to overcome the prior art. For this reason Applicants are entitled to a full scope of protection for rewritten claims 1, 5, 6, and 9 including any judicially created doctrines such as the Doctrine of Equivalents. The entry of these claims for appeal purposes is respectfully requested.

<u>35 U.S.C. § 102(b)</u>

Rejections of claims 1-10 under 35 U.S.C. § 102(b) have been maintained by the Examiner. Examiner's reasons for the rejection are set forth on pages 2-3 of the January 24, 2006 Office Action. This rejection is respectfully traversed.

Applicants' arguments filed November 14, 2006 are not deemed to be persuasive by the Examiner. First, the Examiner alleges that col. 7, lines 62-68, and col. 8, lines 1-29, of Hill teaches "*receiving real-time feedback from the stepper motor for mathematically for obtaining an objective function value...*, i.e., *the processor receives measured and desired profiles for obtaining an objective value function.*" (see page 3 of the January 24, 2006 Office Action). The portions of the Hill reference cited by the Examiner is reproduced below in verbatim:

> Referring now to controller/processor 14 it can be seen that this functional block provides the offset, step size, and step duration data discussed above. This functional block also controls the transistor switches 60 and 62 to specify which of the coils in the stepper motor coil pairs 48/50 and 52/54 are to be supplied with the drive waveforms.

> Real time controller/processor 14 also provides initialization and control

signals to motor count register 76 and shaft encoder 42.

As discussed above, *shaft encoder 42 provides to the controller/processor 14 positional data indicating the actual angular position of stepper motor shaft 44*. Additionally, the controller/processor 14 receives instructions from command interpreter 10 and communicates with memory 92, all over bus 90.

Command interpreter 10 receives instructions from the user 94 which can be a paper tape, an interactive keyboard, a computer or any of the other conventional user sources.

Therefore, in response to instructions from the command interpreter 10, controller/processor 14 generates a sequence of offset, step size and step duration data which are applied to adder 80, adder 78 and timer 86, respectively. In response thereto, a sequence of addresses are generated on address buses 72 and 74 and applied to phase tables 68 and 70, respectively. *The phase tables 68 and 70 respond by each generating a sequence of magnitude data which are converted into phased stairstep drive waveforms by D/A converters 64 and 66, respectively*. The waveforms are then applied to current sinks 56 and 58 to drive the stepper motor 36. It is to be understood that the current sinks can be operational amplifiers, bridge switching drivers, or other current control means.

As understood by Applicants, the paragraphs cited by the Examiner discloses that the shaft encoder provides the controller/processor with the *actual angular position* of the stepper motor shaft, and that phase tables are generated based on the output of the controller/processor. However, the Examiner fails to point out where in the reference does it teach (1) utilizing the actual angular *positions* of stepper motor shaft to generate some sort of a "measured operation profile"; (2) utilizing the "measured operation profile" and the theoretical operation profile, i.e., the desired drive waveform, to generate an *objective function value*; (3) utilizing the objective function value to mathematically evaluate the correspondence between the "measured operation profile" and the desired drive waveform; and (4) utilizing the controller/processor to modify the step size and step duration data, until the objective function value indicates an acceptable degree of correspondence between

the "measured operation profile" and the desired drive waveform. A claim is anticipated only if *every element* as set forth in the claim is found in a single prior art reference. Since Hill fails to teach, disclose or suggest any of the above-mentioned features, the claimed invention cannot be said to be anticipated under 35 U.S.C. § 102(b).

The Examiner also alleges that Fig. 4, item 14, of Hill teaches "*modifying the initial step time sequence instructions... to produce optimized step time sequence instructions, so that the measured operation profile is modified to approach the desired operation profile as stated in abstract and in column 2 lines 26-54.*" (see page 4 of the January 24, 2006 Office Action).

Applicants respectfully maintain that Fig. 4, item 14, by itself, cannot possibly disclose what the Examiner has alleged. Figure 14 is reproduced below in its entirety.



FIG.__4.
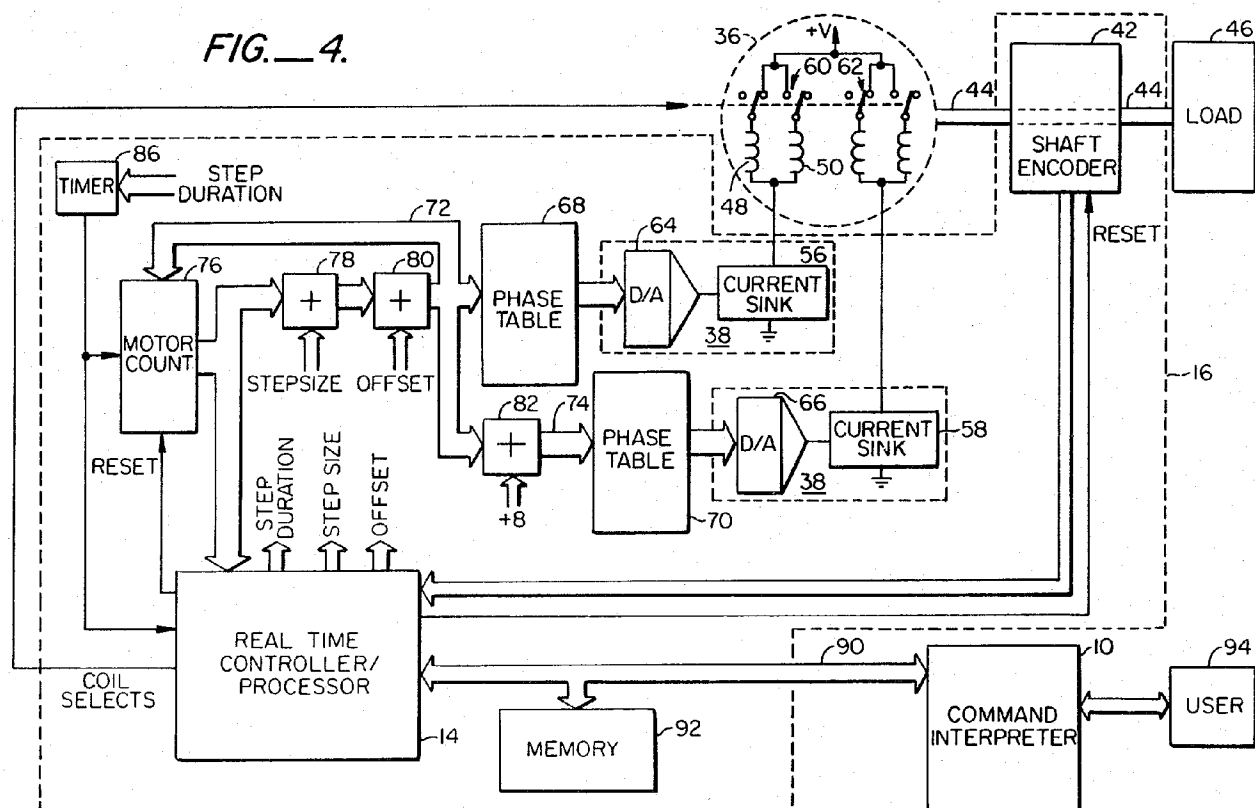
The abstract and col. 2, lines 26-54, are also reproduced below in verbatim:

A method and apparatus for controlling a stepper motor and for force sensing and force control. Stepper motor drive waveforms are provided which are constructed of a sequence of stairsteps, the size and duration thereof being determined as a function of the desired rotational velocity of the stepper motor. Means and a method for accelerating the stepper motor by varying the step size and step duration of the stairsteps in the drive waveform are discussed. Additionally, means and a method are discussed for sensing and controlling the force applied by the stepper motor to a load by way of evaluating the displacement of the actual position of the stepper motor shaft from the commanded or desired position of the shaft. ***Means and a method for implementing a compliant function*** in a similar manner are described. [abstract]

The foregoing and other problems of prior art force-sensing and control methods and apparatus for driving a motor are overcome by the present invention. ***Means are provided for generating step size and step duration data as a function of the velocity at which the motor is desired to be rotated.*** For lower rotational velocities, smaller steps are designated whereas for greater rotational velocities, larger step sizes are designated. Means responsive to the step size data form a stair step drive waveform, for driving the motor, which varies at a frequency which determines the rotational velocity of the motor.

***The step size data designate the number of fractional steps to be used to define a cycle of the drive waveform, while the step duration designates the time interval from fractional step to fractional step.*** The amplitude of each stairstep in the drive waveform is defined according to points selected from a sinusoidal-like curve. These points are spaced apart in phase on the curve by a phase interval which corresponds to a selected multiple of a base phase interval. The base phase interval as used herein corresponds to the smallest fractional step being used. The step size data specifies this selected multiple. The step duration data is selected to set the duration of each step and, hence, the rate of change from step to step. This determines the frequency of the variation of the stairstep drive waveform for a given step size and thereby determines the rotational velocity of the motor.

Here, Hill merely indicates that the step size and step duration data defining the drive waveform may be altered or changed, depending on "the velocity at which the motor is desired to be rotated." (see Hill, col. 2, lines 28-31 and 38-41). No where do the paragraphs relied upon by the Examiner teach or disclose obtaining the actual/measured

drive waveform of the stepper motor, let alone teach or disclose modifying the step size and step duration data, until an objective function value indicative of an acceptable degree of correlation between the actual/measured and the desired waveform is obtained.

The only section of the Hill reference that possibly discusses calibrating the stepper motor is at col. 16 and col. 17, lines 1-61. Hill teaches that phase tables are configured to define points on one cycle of a drive waveform (see Hill, col. 13, lines 12-14). When the system detects slippage, i.e., when the difference in commanded versus actual shaft position is greater than one quarter of a full step (see Hill, col . 16, lines 55-57), it will try to build up the commanded force from its actual present position by having the controller/processor *reference the force table stored in memory to obtain the required deflection for the desired force* (emphasis) (see Hill, col. 16, lines 60-64, and col. 17, lines 2-5). If the error or difference between the actual and commanded position is less than the required deflection, the motor is advanced by one increment (see Hill, col. 16, lines 60-64, and col. 17, lines 2-8). Hill further teaches that the force table referenced by the controller/process is ***derived experimentally from an actual stepper motor*** (emphasis)(see col. 17, lines 44-46; also see col. 16, lines 15-24, stating that:

> One way to obtain definition of such a relationship [deflection vs. load] is to *empirically determine* (emphasis) the same by commanding the stepper motor shaft to a particular position, applying a known load to the shaft, and measuring the angular deflection of the shaft using a shaft encoder.

As it has now been clearly shown, Hill not only fails to teach or disclose creating or building any sort of an operational profile based on the actual or measured data values of the system, which can be used in conjunction with, for example, the desired drive waveform to generate a objective function value, but, in order for the system to be *workable*, Hill also requires additional steps of generating a ***customized force table*** for

each type of stepper motor being driven, loading the table onto the system memory and referencing the force table to perform a *step-wise* calibration of the stepper motor. Hill further requires additional objects or components, such as, force tables customized for different stepper motors, in order to function properly. Accordingly, for these reasons and the others set forth herein, the claimed invention cannot be anticipated because the Hill reference does not teach or disclose every feature recited in claims 1-10 of the present application.

Claim 1 is believed to be patentable for the reasons stated above. Claims 2-4 depend from claim 1, and are therefore believed to be patentable for at least the reasons described above.

Independent claims 5 and 6 are also believed to be patentable for at least the same reasons as claim 1. Furthermore, claims 5 and 6 recite at least one element or limitation not taught or suggested by the prior art.

Claims 5 and 6 recite "program means perturbing each time step" (claim 5) or "running an optimization program...for determining perturbations to the step-time sequence instructions." (claim 6)

The terms "perturbing" and "perturbation" are were previously recited in claim 5 (as originally filed) and therefore, are not newly recited elements or limitations. As the Office is no doubt aware, <u>all</u> limitations of a claim must be considered meaningful, and, "the PTO must consider all claim limitations when determining patentability of an invention over the prior art." *In Re Lowry*, 32 USPQ2d 1031, 1034 (Fed Cir. 1994). The Office does not appear to have considered the limitation of a program means perturbing each time step, and evaluating the objective function for each perturbation, as recited in claim 5. Otherwise, such consideration would have been shown.

Nevertheless, Hill does not teach or suggest "perturbing each time step," as recited in claim 5, or "determining perturbations to the step-time sequence instructions" as recited in claim 6. Hill does not teach or suggest incrementally changing the step-time sequence or determining increments of change to the step-time sequence instructions. Nor does Hill teach evaluating an objective function value for each perturbation as recited in claim 5.

Furthermore, Hill does not teach or suggest inputting an objective function value into an algorithm to determine perturbations to the step-time sequence instructions. Hill does not teach any algorithms.

Hill also does not teach repetition, as recited in claim 8, for minimizing the objective function value and bringing the measure operation profile closer to the desired operation profile.

New claims 9-10 are believed to be patentable for at least the reasons described above.

Accordingly, the application and claims are believed to be in condition for allowance, and favorable action is respectfully requested. No new matter has been added.

If any issues remain which may be resolved by telephonic communication, the Examiner is respectfully invited to contact the undersigned at the number below to advance the application to allowance.

Favorable action is respectfully requested.

Respectfully submitted,

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